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(54) **Pneumatic tyre**

(57) A pneumatic tyre (1) comprising a carcass (6) extending around the tyre (1) from bead (7) to bead (7), sidewalls (4) and a rubber tread region (2) which has a profile when considered in transverse cross section of a new tyre terminating the sides of the tread in inner and outer shoulder regions (5) respectively, each said shoulder region (5) having a shoulder drop (a,b), which is the distance in the radially inward direction from the point of maximum tyre diameter (M) to a shoulder point (P) at the edge of the shoulder region (5), characterised in that when the tyre (1) is mounted on a scheduled wheelrim and inflated to a scheduled pressure, the tread region (2) is asymmetric having its said point of maximum tyre diameter (M) offset in the axial direction of the tyre from the centre line (CL) of the tyre section in the direction of the inner shoulder (5i), and the shoulder drop (a) of the outer shoulder (5o) is greater than the shoulder drop (b) of the inner shoulder (5i) such that the tread region (2) has an asymmetrical profile.

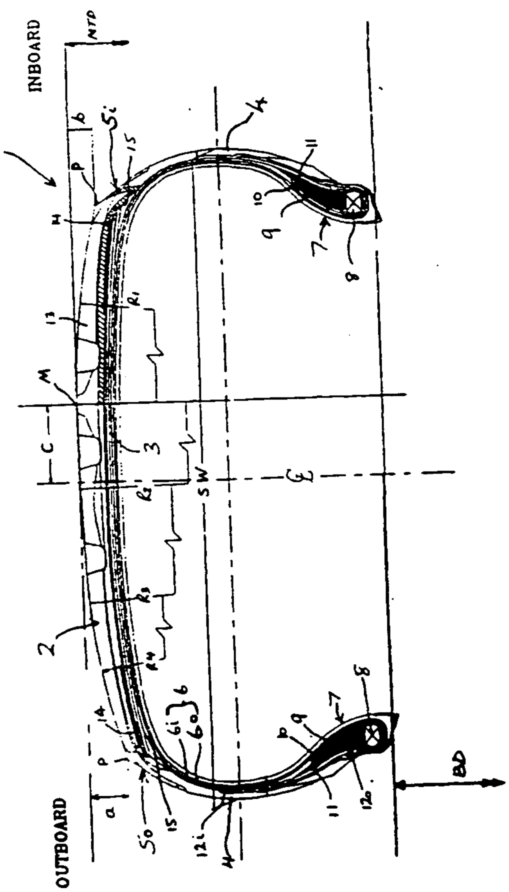

Figure 1

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This invention re..tes to a pneumatic tyre for passenger car and light truck use and in particular to the tread profile of such tyres. It is particularly useful for radial tyres but not limited to these.

Conventionally tyres have a symmetrical tread profile when considered in cross-section to show the curvature in the radial plane. Such a profile, however is not optimised for the generation of the cornering forces necessary for vehicle handling.

Proposals have been made to use different tread compounds at either side of the tyre for improved wet grip and for different tread pattern groove layouts at either side of the tread both of which provide some asymmetry. The latter also gives increased pattern density on the outside half of the tyre to improve cornering when that part of the tyre is carrying most of the cornering forces but there is a reduction in wet grip due to poorer drainage.

Conventional tyres use dual radii tread profiles. The central region of the tread has one large radius and the shoulders have a second substantially smaller radius. This is to provide a wider flatter tread with a more uniform contact patch to the road.

Japanese Patent publication 3271003 proposed an asymmetrical profile shape in which the outer part of the tread of the tyre, when fitted to a vehicle, has a smaller radius than the inner part to allegedly improve wet grip.

US 4763708 proposed that the transverse sectional plane has a maximum outer diameter point spaced axially from the central plane of the tread and the radius of curvature of the narrower side is greater than the other side to improve the resistance to abrasion of the shoulder regions.

It has also been proposed to stiffen the inboard sidewall of the tyre so that more load is carried by that sidewall to offset some of the load transfer during cornering but the bulk of the material in the stiffened sidewall increases heat generation leading to durability problems.

The above tyres, however, do not optimise contact patch load distribution while cornering and thus lateral grip and handling are not optimised and uneven wear occurs. Furthermore for high cornering powers known tyres are very wide which increases cost and leads to installation problems on vehicles.

It is an object of the present invention to improve lateral grip and handling properties of a tyre particularly during cornering of the vehicle whilst minimising the tyre width.

According to the present invention, there is provided a pneumatic tyre comprising a carcass extending around the tyre from bead to bead, sidewalls and a rubber tread region which has a profile when considered in transverse cross-section of a new tyre terminating the sides of the tread in inner and outer shoulder regions respectively, each said shoulder region having a shoulder drop, which is the distance in the radially inward direction from the point of maximum tyre diameter to a shoulder point at the edge of the shoulder region, wherein when the tyre is mounted on a scheduled rim and inflated to a scheduled pressure the tread region is asymmetric having its said point of maximum tyre diameter offset in the axial direction of the tyre from the centre line of the tyre section in the direction of the inner shoulder edge, and the shoulder drop of the outer shoulder is greater than the shoulder drop of the inner shoulder such that the tread region has an asymmetrical profile.

By the shoulder point at the edge of the shoulder region is meant the point which is the radially outer edge of the shoulder region of the tyre sidewall. For a tyre having a curved shoulder region, typical of modern tyres, this shoulder point is found at the intersection of the extension of the line defining the tread surface and the extension of the line defining the sidewall surface.

Inner and Outer refer to the two shoulders of the tyre respectively and in use on a vehicle specify the positions of each shoulder.

Preferably the tyre is a radial tyre having a tread region reinforced by a breaker belt.

The ratio of the shoulder drop of the outer shoulder to the shoulder drop of the inner shoulder may be greater than 1.25. Preferably the ratio is in the range of 1.25 to 5.0. The inner shoulder drop may be in the range of 8 to 14mm and the outer shoulder drop may be in the range 12 to 22mm.

The tread profiles on opposite sides of the point of maximum tyre diameter may have different radii of curvature and the tread profile on the side of the outer shoulder may have plural radii of curvature.

To assist in understanding the invention reference is made to the attached drawings wherein:

Figure 1 is a cross-sectional view taken in a plane passing through the rotational axis of an asymmetrical tyre according to the present invention: and

Figure 2 is a conventional tyre.

The tyres 1,100 shown in Figures 1 and 2 respectively are both P245/50R16 size tyres having a bead diameter BD of 403.1mm, and moulded dimensions of maximum section width SW of 274mm and a maximum tyre diameter MTD of 650mm.

The tyres 1,100 comprise a carcass 6 extending between two bead regions 7 through sidewalls 4 and a ground

contacting tread region 2. Between the axial edges of the tread region 2 and the sidewalls 4 are tyre shoulder regions 5.

The carcass 6 comprises 2 plies 6i,6o of radially extending cords which are turned around inextensible bead coils 8 located one in each bead region 7 from the axial inside to the outside to form ply turn-ups 12i,12o respectively. The ply turn-ups 12i and 12o extend to heights of 70mm and 20mm respectively above the bead diameter BD.

In each bead region between the carcass plies 6i,6o and the ply turn-ups 12i,12o is disposed a rubber apex 9 of hardness 93 Shore A which extends taperingly radially outward from the bead coil 8 and terminates at a position between the ends of the ply turn-ups 12i,12o. In each bead region between the apex 9 and the radially outer carcass ply 6o is disposed a flipper 10 comprising textile cords. This extends along the axially inner surface of the apex 8 from a position radially inward of the radially outer end of the apex and is wrapped around the bead and terminated on the axially outer side of the apex 9 at a radial height below that of the end of the ply turn-up 12o. The bead region 7 is further provided with a sidewall insert 11 comprising a ply of rubbered steel covered cords laid at 70° to the radial direction extending along the axially outer side of the apex 10 from a radially inward position below the end of the ply turn-up 12o radially outward beyond the end of the apex 10 and between the carcass ply 6o and the ply turn-up 12i to a position radially inward of the end of the ply turn-up 12i.

The ground contacting tread region 2 comprises a tread rubber 13 reinforced by a breaker belt or assembly 3 disposed radially outward of the carcass 6. The breaker assembly 3 comprises two plies of breaker fabric comprising rubber coated steel cords laid parallel to each other and oppositely inclined at an angle of 24° to the circumferential direction of the tyre such that the cords of one ply cross the cords of the other ply. The cords of the breaker have 2+2x0.25mm structure laid at a density of 23 cords per inch. The breaker assembly 3 extends substantially the whole width of the ground contacting tread region 2 and the radially inner breaker ply is wider than the radially outer breaker ply.

In the axially outer regions, the breaker assembly is covered by an edge bandage 14 comprising nylon reinforcing cords. This edge bandage extends beyond the edge of the breaker assembly.

The extreme edges of the breaker assembly 3 are supported by a breaker cushion 15 disposed radially inward of the edge of the breaker assembly in the tyre shoulder regions 5. Thus the curvature of the breaker assembly is maintained across the entire width.

In both tyres 1,100 of Figures 1 and 2 the profiles of the carcass 6, the sidewalls 4 and the bead regions 7 including the positions of the components therein are substantially symmetrical about the axial centreline CL of the tyre which lies in the tyre circumferential plane.

In the conventional tyre 100 of Figure 2 the profile of the tread region is also symmetrical with respect to the axial centreline CL. Accordingly the maximum tyre diameter MTD is located on the tread outer surface at a point M of intersection with the axial centreline CL and the curvature of the tread surface to either side of the axial centreline CL is the same. Accordingly the shoulder drop d, which is defined as the distance in the radial direction between the point M on the tread surface of the maximum tyre diameter and the shoulder point P on the radially outer edge of the shoulder region 5 at the boundary with the tread region 2, is the same on both sides of the tyre. As previously mentioned in the case of tyres having rounded shoulders such as those of Figures 1 and 2 the shoulder point P is located at the intersection of the extensions of the lines defining the tread and sidewall surfaces. In the tyre of Figure 2 the shoulder drop is 14.1mm when the tyre is mounted on a 16" x 8" wheelrim and inflated to a pressure of 30psi.

In contrast to the conventional tyre, the present inventive tyre 1 of Figure 1 has a tread profile which is asymmetrical with respect to the axial centreline of the tyre. The present tyre has its maximum tyre diameter MTD at a point M on the tread surface offset by a distance C from the axial centreline CL of the tyre in the direction of the tyre inner shoulder. In the case of the present embodiment the distance C is 33.5mm. Furthermore the curvature of the tread to either side of the point M is different. In the present embodiment the tread surface lying to the right of the point M has a single curvature R1 whilst the tread surface lying to the left of the point M has a curvature defined by three radii R2, R3, and R4. The radii R1 and R2 have a common tangent at the point M. In this embodiment the values of R1-R4 for the moulded tyre are 360mm, 1420mm, 350mm and 292.2mm respectively. Accordingly the shoulder drop of the present asymmetric tyre is different on either side. The shoulder drop b of the inner shoulder 5i lying nearest to the point M is 11.3mm whilst the shoulder drop a of the outer shoulder 5o lying further from the point M is 19.8mm when the tyre is mounted on a 16" x 8" wheelrim and inflated to a pressure of 30psi.

Tyres having constructions according to Figures 1 and 2 but having identical tread patterns were tested using a 1993 model Z28 Camaro high performance passenger vehicle.

The asymmetric tyre was fitted to all four wheels of the vehicle such that the point M of the maximum tyre diameter MTD was nearest the inboard wheel flange, i.e. the larger shoulder drop a (= 19.8mm) was towards the outside of the wheel.

The asymmetric and conventional constructions were assessed for ride and handling characteristics and also tread temperature. Details of these tests and results are shown in Table 1. The results of the mild handling and ride tests are presented in Table 1 as a subjective ranking wherein a higher value represents a better performance.

The test results presented in Table 1 show that the asymmetric construction improved mild and maximum subjective handling and also improved measured lateral acceleration and records lap times. Slightly heavier steering on-centre

ıcker response contributed to a more confident feel while driving on the asymmetric tyre. During moderate lane es. the asymmetric tyre exhibited less tendency to slide out. Under maximum handling conditions the asymmetric uction provided better 'turn-in'. i.e. steering response from maximum deceleration to maximum cornering and progression at the limit.

ıe loaded tyre temperatures were measured immediately after the completion of the lateral acceleration test ı was carried out by driving the vehicle in a circle on an asphalt surface. The recorded temperature profiles pre- :d in Table 1 are for the outside pair of tyres in the lateral acceleration test. The temperature profiles show the ımetric tyre had a more uniform temperature distribution implying that the load is distributed more evenly and the ı contact area is being used more efficiently. Furthermore the maximum tyre temperature of the asymmetric tyre duced by 10°C which would increase the resistance to tread chunking and abrasion under maximum handling ditions.

The cornering characteristics of the present asymmetric tyre compared with the conventional tyre were further ermined by the measurement of lateral force at various slip angles. This testing was carried out using an MTS 1 ı-Trac test machine. The asymmetric tyre was mounted on the test rim such that turning the tyre towards the shoulder ıing the lesser shoulder drop b corresponds to a negative slip angle and positive force direction in standardised ce and moment terms. Testing was carried out at 25%. 50% and 100% of the scheduled tyre load of 715kg over a ıge of slip angles of -15 to +15 degrees. Results of these tests are shown in Table 2.

The results of Table 2 clearly show that the asymmetric tyre generates more cornering force throughout the entire nge of negative slip angles. i.e. when the tyre is turning towards the shoulder having the lesser shoulder drop b. In e slip angle range of 0 to +3.0 degrees. i.e. when the tyre is turned slightly towards the shoulder having the greater ıoulder drop. the conventional symmetrical tyre generates slightly more cornering power. This is thought to be due ı residual cornering force RCF. However as the tyre is turned further in this direction at slip angles of +3.0 and higher ıe asymmetric tyre again shows greater cornering power.

Accordingly the data presented in Table 2 is in accordance with the vehicle test results of Table 1. In Table 2 the data for 100% load is the nearest representation of a maximum cornering situation in which almost all of the vehicle load is on the outside tyres. The negative slip angle results of Table 2 represent the situation when the outside tyres are tyres properly orientated to take advantage of the asymmetric effect. The asymmetric tyre has greater cornering power and a significantly reduced rate of cornering power loss as slip angle increases beyond the peak. This is manifest as higher lateral acceleration and improved breakaway characteristics noted during the maximum handling tests. Furthermore since it is known that with conventional tyres the rate of cornering power loss as the slip angle is increased beyond the peak increases with speed it is the case that with increasing speeds the asymmetric tyre will corner increasingly better than the conventional tyre with straight-ahead running where slip angles are low and there is little load transfer on the tyres the situation is represented by the 50% load results of Table 2. The asymmetric tyre doubles the inward force on each side of the vehicle while running straight ahead. This is thought to be the reason for the heavier on-centre feel observed in the vehicle handling test. At 1.0 degree of slip angle. the asymmetric tyre on the loaded side generates 10% more cornering power which is thought to contribute to the observed off-centre response.

Whilst the above-described embodiment has a tread profile defined by three radii of curvature on the side of the tread having the greater shoulder drop and a single radius of curvature on the opposite side of the point of maximum tyre diameter it should be appreciated that other tread profiles are possible within the scope of the invention. For example the tread profile may have a single radius of curvature on both sides of the point of maximum tyre diameter or may have a plurality of radii on either or both sides.

Also whilst the above-described embodiment has the ratio of the shoulder drop of the outer tyre shoulder to the shoulder drop of the inner tyre shoulder set at a value of 1.75. this ratio may have within the invention any value greater than 1.25 or more preferably in the range of 1.25 to 5.0 giving the above described advantages.

TABLE 1

TIRE	A	B
CONSTRUCTION	FIGURE 2	FIGURE 1
FEATURE	CONTROL CONVENTIONAL PROFILE	[illegible]DIEMENT ASYMMETRICAL PROFILE
SIZE	P245/50ZR16	P245/50ZR16
MILD HANDLING	6.3	6.2
STEERING RESPONSE LINEARITY	6.5	6.6

TABLE 1 (continued)

E	A	B
ONSTRUCTION	FIGURE 2	FIGURE 1
ATURE	CONTROL CONVENTIONAL PROFILE	EMBODIEMENT ASYMMETRICAL PROFILE
ZE	P245/50ZR16	P245/50ZR16
ILD HANDLING		
ANE CHANGE	6.5	6 7
COMMENTS		HEAVIER CENTER FEEL
RIDE		
HARSHNESS-LARGE	6	6.1
HARSHNESS-SMALL	6	6
DAMPING	6	6
MAXIMUM HANDLING		
LAP TIME (sec)	43.59	43 18
LAP INDEX	100	102
LATERAL ACC'L'N (g)	0.85	0.88
TRANSIENT STABILITY	6.5	6 8
PROGRESSION	6.5	6 6
COMMENTS		SUPERIOR RESPONSE PROGRESSION
LOADED TIRE TEMP. (Deg. C) (INBOARD. CENTRE. OUTBOARD)		
FRONT	75 . 125 . 150	85 125 140
REAR	65. 90. 95	70. 95. 90
TEST CONDITIONS		
VEHICLE	1993 Z28 CAMARO	1993 Z28 CAMARO
WHEELRIM	16x8	16x8
TIRE INFLATION PRESSURE	30 PSI ALL	30 PSI ALL
WEATHER	CLOUDY	CLOUDY
AMBIENT TEMP (Deg. C)	30	30

TABLE 2

TIRE A

FORCE AND MOMENT TEST RESULTS

SLIP ANGLE (Deg) \ LOAD (Kg)	LATERAL FORCE (Kg) 179	358	715	ALIGNING TORQUE (Nm) 179	358	715	LOAD SENSITIVITY 179-358	358-715	CORNERING COEFICIENT 179	358	715
-15	126.6	225.8	430.5	0.3	0.1	0.4	0.554	0.573	0.707	0.631	0.602
-12	132.0	234.2	457.2	0.2	0	0	0.571	0.625	0.737	0.654	0.639
-9	140.8	246.6	489.7	0.2	-0.2	-0.7	0.591	0.681	0.787	0.689	0.685
-8	143.5	251.7	501.5	0.1	-0.3	-1.1	0.604	0.7	0.802	0.703	0.701
-7	147.9	253.7	505.8	0	-0.5	-2.3	0.591	0.706	0.826	0.709	0.707
-6	149.5	262.4	517.7	0.1	-0.6	-3.4	0.631	0.715	0.835	0.733	0.724
-5	149.4	266.2	516	-0.1	-1.3	-5.2	0.653	0.7	0.835	0.744	0.722
-4	147.7	270.1	518.2	-0.3	-1.5	-7.9	0.684	0.695	0.823	0.754	0.725
-3	139.9	259	475.3	-0.6	-2.5	-11.1	0.663	0.606	0.782	0.723	0.665
-2	119.6	221.3	378.5	-1	-3.7	-14.3	0.568	0.44	0.668	0.618	0.529
-1	78.9	141.6	213.7	-1.2	-3.8	-12.6	0.35	0.202	0.441	0.396	0.299
0	4.3	10.2	12.1	-0.2	-0.7	-1.9	0.033	0.005	0.024	0.028	0.017
1	-79.2	-125.4	-185	1	2.9	9.6	-0.292	-0.167	-0.409	-0.35	-0.259
2	-116.8	-214	-363.6	0.9	3.5	13.9	-0.543	-0.419	-0.653	-0.598	-0.509
3	-137.3	-256.9	-469.9	0.6	2.4	11.1	-0.668	-0.597	-0.767	-0.718	-0.657
4	-144	-269.3	-515.1	0.4	1.5	8.1	-0.7	-0.689	-0.804	-0.752	-0.72
5	-144.7	-267.2	-525.1	0.7	1.1	5.3	-0.684	-0.722	-0.808	-0.746	-0.734
6	-144.4	-263.3	-527.6	0	0.6	3.6	-0.664	-0.74	-0.807	-0.735	-0.738
7	-143.4	-258.2	-514.8	0	0.5	2.4	-0.641	-0.719	-0.801	-0.721	-0.72
8	-140.7	-250.3	-500.5	-0.1	0.4	1.3	-0.612	-0.701	-0.786	-0.699	-0.7
9	-139.2	-246.4	-497.6	-0.2	0.3	0.7	-0.599	-0.704	-0.778	-0.688	-0.696
12	-130.8	-229.6	-471.3	-0.3	0.2	-0.4	-0.552	-0.677	-0.731	-0.641	-0.659
15	-122.6	-217.5	-441.8	-0.3	0.2	-0.3	-0.53	-0.628	-0.685	-0.608	-0.618

TABLE 2 (Continued)

FORCE AND MOMENT TEST RESULTS

TIRE B

SLIP ANGLE (Deg) \ LOAD (Kg)	LATERAL FORCE (Kg) 179	358	715	ALIGNING TORQUE (Nm) 179	358	715	LOAD SENSITIVITY 179-358	358-715	CORNERING COEFICIENT 179	358	715
-15	137.5	238.3	513.2	0.3	0.1	0.4	0.563	0.77	0.768	0.666	0.718
-12	144.3	243.8	543.4	0.3	-0.1	0	0.556	0.839	0.806	0.681	0.76
-9	150.7	254.6	577	0.2	-0.2	-0.5	0.58	0.903	0.842	0.711	0.807
-8	154.6	262.2	584.4	0.2	-0.2	-1	0.601	0.903	0.864	0.732	0.817
-7	156.5	271.2	581.6	0.3	-0.3	-3	0.641	0.849	0.874	0.755	0.813
-6	157	275.1	579.5	0.1	-0.4	-4.3	0.66	0.853	0.877	0.768	0.81
-5	155.8	274.7	572.8	-0.1	-1.5	-6	0.664	0.835	0.87	0.767	0.801
-4	152.5	273	524.4	-0.3	-1.3	-8.8	0.673	0.755	0.852	0.763	0.759
-3	144.1	258.8	488.1	-0.6	-2.2	-11.4	0.641	0.642	0.805	0.725	0.683
-2	124.7	227.8	385.7	-1.1	-3.4	-13.7	0.576	0.442	0.697	0.636	0.539
-1	83.9	149.7	225.1	-1.2	-3.8	-11.6	0.368	0.211	0.469	0.418	0.315
0	7.4	15.6	30.5	-0.2	-0.6	-1.4	0.046	0.042	0.041	0.044	0.045
1	-75.3	-125.2	-162.5	0.9	3.2	10.5	-0.279	-0.104	-0.421	-0.35	-0.227
2	-120.7	-218.6	-357.1	0.9	3.6	16	-0.547	-0.388	-0.674	-0.611	-0.499
3	-142	-261.3	-483.8	0.5	2.4	12.6	-0.666	-0.623	-0.793	-0.75	-0.677
4	-150.1	-275.7	-537.8	0.2	1.5	8.9	-0.702	-0.734	-0.839	-0.77	-0.752
5	-154.7	-281.5	-559.3	0	1.2	6.3	-0.708	-0.778	-0.864	-0.786	-0.782
6	-153.9	-281.4	-562.9	-0.1	0.5	4.4	-0.712	-0.789	-0.86	-0.786	-0.787
7	-154.2	-280.8	-562.8	-0.2	0.4	3.4	-0.707	-0.79	-0.861	-0.784	-0.787
8	-150.9	-275	-546.5	-0.2	0	2.4	-0.693	-0.761	-0.843	-0.768	-0.764
9	-150.5	-272.2	-544	-0.3	0	1.7	-0.681	-0.761	-0.84	-0.76	-0.761
12	-143	-257.9	-532.6	-0.4	0.1	0.3	-0.642	-0.769	-0.799	-0.72	-0.745
15	-135.4	-244.8	-518.3	-0.4	0.1	-0.7	-0.611	-0.766	-0.756	-0.684	-0.725

neumatic tyre (1) comprising a carcass (6) extending around the tyre (1) from bead (7) to bead (7) sidewalls and a rubber tread region (2) which has a profile when considered in transverse cross section of a new tyre minating the sides of the tread in inner and outer shoulder regions (5) respectively, each said shoulder region having a shoulder drop (a,b), which is the distance in the radially inward direction from the point of maximum e diameter (M) to a shoulder point (P) at the edge of the shoulder region (5), characterised in that when the tyre is mounted on a scheduled wheelrim and inflated to a scheduled pressure, the tread region (2) is asymmetric aving its said point of maximum tyre diameter (M) offset in the axial direction of the tyre from the centre line (CL) the tyre section in the direction of the inner shoulder (5i), and the shoulder drop (a) of the outer shoulder (5o) is greater than the shoulder drop (b) of the inner shoulder (5i) such that the tread region (2) has an asymmetrical profile.

A tyre according to claim 1, characterised in that the tyre has a radial carcass (6) and the tread region (2) is reinforced by a breaker belt (3).

A tyre according to either of claims 1 or 2, characterised in that the ratio of the shoulder drop (a) of the outer shoulder (5o)to the shoulder drop (b) of the inner shoulder (5i) is greater than 1.25.

A tyre according to either of claims 1 or 2, characterised in that the ratio of the shoulder drop (a) of the outer shoulder (5o) to the shoulder drop (b) of the inner shoulder (5i) is in the range of 1.25 to 5.0.

A tyre according to either of claims 1 or 2, characterised in that the ratio of the shoulder drop (a) of the outer shoulder (5o) to the shoulder drop (b) of the inner shoulder (5i) is substantially 1.75.

6. A tyre according to any of claims 1 to 5, characterised in that the shoulder drop (b) of the inner shoulder (5i) is in the range 8 to 14mm.

7. A tyre according to any of claims 1 to 6, characterised in that the shoulder drop (a) of the outer shoulder (5o) is in the range 12 to 22mm.

8. A tyre according to either of claims 1 or 2, characterised in that the shoulder drop (b) of the inner shoulder (5i) is 11.3mm and the shoulder drop (a) of the outer shoulder (5o) is 19.8mm

9. A pneumatic tyre according to any of claims 1 to 8, characterised in that the tread profiles on opposite sides of the point of maximum tyre diameter (M) have different radii of curvature

10. A pneumatic tyre according to any of claims 1 to 9, characterised in that the tread profile on the side of the point of the maximum tyre diameter (M) having the largest shoulder drop (a) is defined by a plurality of radii of curvature (R2,R3,R4).

11. A pneumatic tyre according to claim 10, characterised in that the tread profile on the side of the point of maximum tyre diameter (M) having the largest shoulder drop (a) is defined by three radii of curvature (R2,R3,R4).

12. A pneumatic tyre according to claim 11, characterised in that the tread profile on the opposite side of the point of maximum tyre diameter has a single radius of curvature (R1)

13. A pneumatic tyre according to claim 9 characterised in that the radii of curvature (R1,R2) on opposite sides of and immediately adjacent to the point of maximum tyre diameter (M) have a common tangent at the point of maximum tyre diameter (M).

FIGURE 1

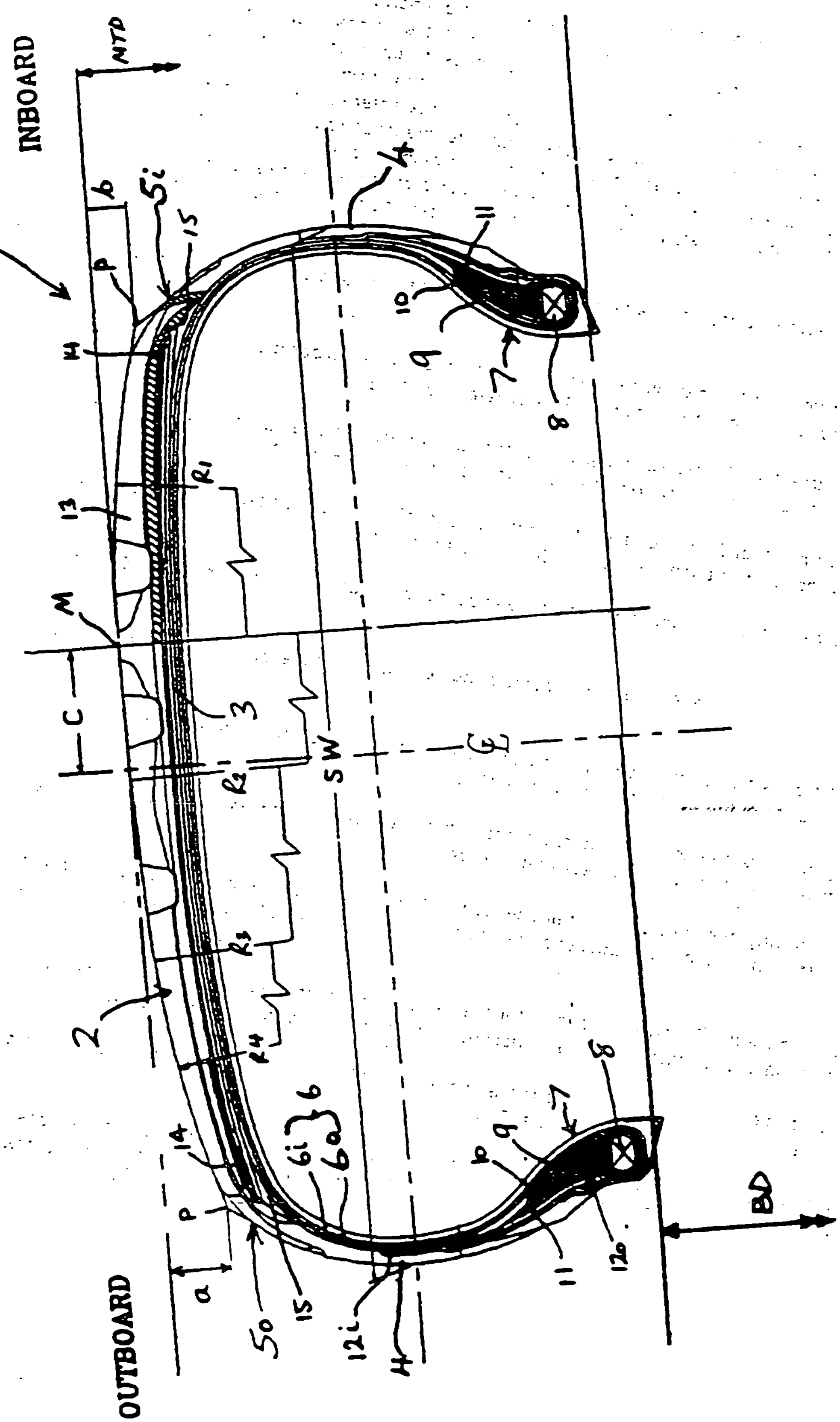
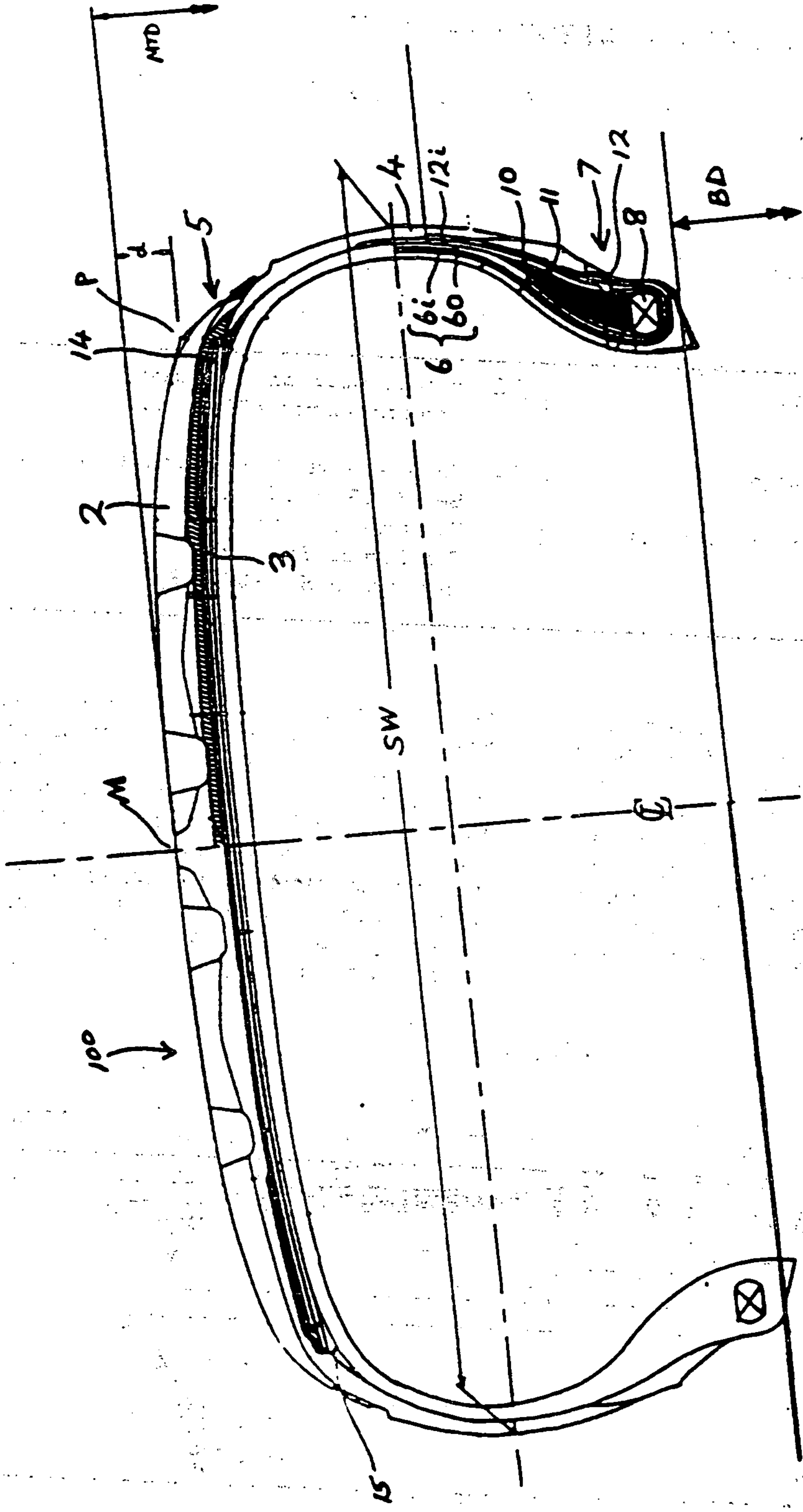


FIGURE 2



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(12) # EUROPEAN PATENT APPLICATION

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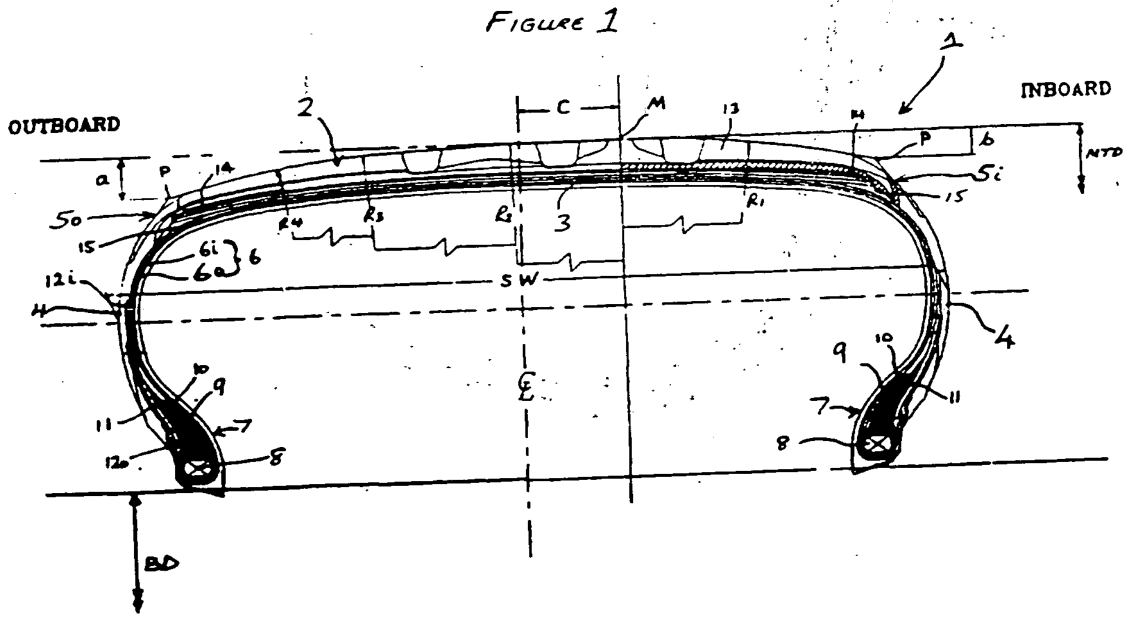
(54) **Pneumatic tyre**

(57) A pneumatic tyre (1) comprising a carcass (6) extending around the tyre (1) from bead (7) to bead (7), sidewalls (4) and a rubber tread region (2) which has a profile when considered in transverse cross section of a new tyre terminating the sides of the tread in inner and outer shoulder regions (5) respectively, each said shoulder region (5) having a shoulder drop (a,b), which is the distance in the radially inward direction from the point of maximum tyre diameter (M) to a shoulder point (P) at the edge of the shoulder region (5), characterised in that when the tyre (1) is mounted on a scheduled wheelrim and inflated to a scheduled pressure, the tread region (2) is asymmetric having its said point of maximum tyre diameter (M) offset in the axial direction of the tyre from the centre line (CL) of the tyre section in the direction of the inner shoulder (5i), and the shoulder drop (a) of the outer shoulder (5o) is greater than the shoulder drop (b) of the inner shoulder (5i) such that the tread region (2) has an asymmetrical profile.

FIGURE 1



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 5351

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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A	US 5 301 728 A (BROWN JR JACK E ET AL) 12 April 1994 * claims; figures *	1	
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B60C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 April 1997	Baradat, J-L

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